2015 I-code R-values and best practices

presented by

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IBC 2015:
Ch. 15: Roofing
• Sec. 1511: Reroofing
Ch. 13: Energy efficiency
• References IECC 2015
2015 I-code R-values and best practices
Building Enclosure Council (BEC) - Baltimore

IRC 2015:
Ch. 9-Roof assemblies
• Sec. R908-Reroofing
Ch. 11-Energy efficiency
• References IECC 2015

IECC 2015:
Commercial buildings:
• All except “Residential Buildings”
Residential buildings:
• One- and two-family dwellings, multiple single-family dwellings and Group R-2, R-3 and R-4 buildings three stories or less
Format of IECC 2015

**Commercial (CE):**
- Ch. 1- Scope
- Ch. 2- Definitions
- Ch. 3- General requirements
- Ch. 4- Commercial energy efficiency
- Ch. 5- Existing buildings
- Ch. 6- Reference standards

**Residential (RE):**
- Ch. 1- Scope
- Ch. 2- Definitions
- Ch. 3- General requirements
- Ch. 4- Residential energy efficiency
- Ch. 5- Existing buildings
- Ch. 6- Reference standards
- Appendix RA- Atmospheric venting
- Appendix RB- Solar-ready provisions

*Residential provisions are not addressed in this presentation*
IECC 2015, Fig. C301.1-Climate zones

Fig. R301.1 (residential climate zones) is similar

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C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.

2. The requirements of Sections C402 through C405. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.

3. The requirements of Sections C402.5, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
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C402.1.1 Low-energy buildings. The following low energy buildings, or portions thereof separated from the remainder of the building by building thermal envelope assemblies complying with this section, shall be exempt from the building thermal envelope provisions of Section C402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft² (10.7 W/m²) or 1.0 watt per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.

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C402.2.2 Roof assembly. The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions: [next slide]
Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.
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Exceptions:
1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted U-factor is equivalent to the same assembly with the R-value specified in Table C402.1.3.
2. Where tapered insulation is used with insulation entirely above deck, the R-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the R-value specified in Table C402.1.3.
3. Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

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Roofing-specific adaptation of Table C402.1.3

Commercial Buildings (Insulation component R-value-based method)

<table>
<thead>
<tr>
<th>Climate zone</th>
<th>Assembly description</th>
<th>Insulation entirely above deck</th>
<th>Metal buildings</th>
<th>Attic and other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>R-20ci (all other)</td>
<td>R-19 + R-11 LS</td>
<td>R-38</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>R-25ci (Group R)</td>
<td>R-25ci</td>
<td>R-38 (except Marine 4)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>R-30ci</td>
<td>R-19 + R-11 LS</td>
<td>R-38 (all other)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>R-49 (Group R, Marine 4)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>R-38 (all other)</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>R-49</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ci = Continuous insulation; LS = Liner system
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C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

**Exceptions:** [next slide]

<table>
<thead>
<tr>
<th>TABLE C402.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS</td>
</tr>
<tr>
<td>Three-year solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75</td>
</tr>
<tr>
<td>Three-year-aged solar reflectance index of 64</td>
</tr>
</tbody>
</table>

[Footnotes omitted for clarity]

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**Exceptions:** The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that include or are covered by the following:
   1.1. Photovoltaic systems or components.
   1.2. Solar air or water-heating systems or components.
   1.3. Roof gardens or landscaped roofs.
   1.4. Above-roof decks or walkways.
   1.5. Skylights.
   1.6. HVAC systems and components, and other opaque objects mounted above the roof.

2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings. [Continued...]
3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot [74 kg/m²] or 23 psf [117 kg/m²] pavers.

4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

**C402.3.1 Aged roof solar reflectance.** Where an aged solar reflectance required by Section C402.3 is not available, it shall be determined in accordance with Equation 4-3.

\[ R_{\text{aged}} = [0.2 + 0.7(R_{\text{initial}} - 0.2)] \]  

(Equation 4-3)

where:

- \( R_{\text{aged}} \) = The aged solar reflectance.
- \( R_{\text{initial}} \) = The initial solar reflectance determined in accordance with CRRC-1.

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*C402.5 Air leakage—thermal envelope (Mandatory)*. The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (0.2 L/s · m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.
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**C402.5.1 Air barriers.** A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

*Exception:* Air barriers are not required in buildings located in Climate Zone 2B.

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**C402.5.1.2 Air barrier compliance options.** A continuous air barrier for the opaque building envelope shall comply with Section C402.5.1.2.1 or C402.5.1.2.2.

**C402.5.1.2.1 Materials.** Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s · m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer’s instructions.

[Continued...]

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1. - 4. ...

5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m³) having a thickness of not less than 1½ inches (38 mm)

6. - 8. ...


10. Modified bituminous roof membrane.


12. - 16. ...

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C402.5.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft² (0.2 L/s · m²) under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.

2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.

3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.
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Sec. C503-Alterations:

C503.3 Building envelope. New building envelope assemblies that are part of the alteration shall comply with Sections C402.1 through C402.5.

C503.3.1 Roof replacement. Roof replacements shall comply with Table C402.1.3 or C402.1.4 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck.

*Roof replacements shall comply to the same IECC 2015 requirements as new construction*

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SECTION C504

REPAIRS

C504.1 General. Buildings and structures, and parts thereof, shall be repaired in compliance with Section C501.3 and this section. Work on nondamaged components that is necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section C501.3, ordinary repairs exempt from permit and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.

Where a building was constructed to comply with ANSI/ASHRAE/IESNA 90.1, repairs shall comply with the standard and need not comply with Sections C402, C403, C404 and C405.
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C504.2 Application. For the purposes of this code, the following shall be considered repairs:

1. ...
2. Roof repairs.
3. Air barriers shall not be required for roof repair where the repairs to the building do not include alterations, renovations or repairs to the remainder of the building envelope.
4. ...
5. ...

In summary: IECC 2015 – Commercial (CE)

• R-value
• Roof reflectivity (Climate Zones 1-3 only)
• Air retarders (All Climates Zones except 2B)
• Roof replacement:
  – R-value requirements to IECC 2015 levels
  – Roof reflectivity per IECC 2015
  – Air retarder per IECC 2105 (whole building envelope replacement only)
Insulation R-values

C303.1.4 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission R-value rule (CFR Title 16, Part 460) in units of h \cdot \text{ft}^2 \cdot \text{°F/Btu} at a mean temperature of 75°F (24°C).

Long-term thermal resistance (LTTR)

- ASTM C1303
- ULC-S 770

LTTR is intended to represent the R-values of specimens tested after five years of aging when stored in a controlled laboratory environment. This five-year figure corresponds closely to a predicted 15-year, time weighted average of R-values.
NRCA R-values testing

- Polyisocyanurate (2009 and previous)
- Expanded polystyrene (2010)
- Extruded polystyrene (2010)
- Polyisocyanurate (2015)
Design R-value recommendation
Polyisocyanurate insulation

1986-2011:
• R = 5.6 per inch thickness

2012-2015:
• R = 5.6 per inch thickness (cooling climates)
• R = 5.0 per inch thickness (heating climates)

Beginning in 2016:
• R = 5.0 per inch thickness

NRCA recommendation
In purchase orders and contracts, identify insulation by its thickness, not its R-value.
NRCA “Industry Issue Update,”
November 2014
Payback analysis:
• 100 sq. single story building
• Costs per R+5 increases
• Energy savings per R+5 increases
• Local energy costs
• Cost ÷ Savings = Payback
• 16 cities in 8 climate zones
Payback results (Philadelphia, PA):
• R-10 to R-15: 7.5 yrs.
• R-15 to R-20: 15.5 yrs.
• R-20 to R-25: 24.9 yrs.
• R-25 to R-30: 54.3 yrs.

NRCA code manuals
shop.nrca.net or (866) ASK-NRCA
Consider joining ICC

Membership categories:
- Corporate member: $400 (complete collection)
- Building safety professional member: $150 (1 code)

http://www.iccsafe.org/Membership/Pages/join.aspx

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